technology ■ opportunity

National Aeronautics and Space Administration
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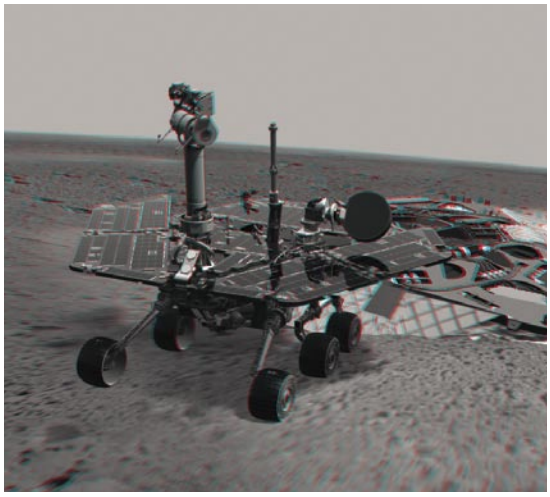
sensors and actuators

A Low-Power, Portable X-Ray Fluorescence (XRF) System

...for rapid, nondestructive detection of chemical elements



NASA Goddard Space Flight Center invites companies to license technology for a battery-operated, rugged, highly sensitive device for performing in-the-field nondestructive elemental analysis. This system design is compact, low weight, and low power and can operate at variable voltages of up to 60 kilovolts and variable currents of up to 100 microamps, obtaining accurate results quickly.

This XRF technology can detect any chemical element, even in very small amounts. Plus, it is uniquely capable of detecting trace amounts of heavy elements, such as barium (Ba), antimony (Sb), lead (Pb), and strontium (Sr). The technology can be used wherever rapid, nondestructive, *in situ*, analysis of chemical elements is needed. It was developed specifically to address the needs of NASA and forensic investigations, but many other Earth-based applications exist.

Benefits

- **Sensitive**: This technology can detect materials at the parts-per-million (ppm) level. Tests have shown that the system is capable of detecting milligram concentrations of Ba, Sb, Pb, Sr, and other elements.
- **Advanced analytics**: Using software algorithms based upon NASA research, the technology detects the relative amounts of elemental constituents, which can be used to identify the possible presence of gunshot residue and other crime scene evidence.
- **Automated, remote operations**: The system can be fully automated and operated remotely if required.
- **Higher voltage**: The system is designed with an X-ray tube that can operate up to 60 keV, which provides the ability to complete measurements to the ppm-level in a shorter time and to identify heavier elements than with the 40 keV tubes typically found in portable XRF systems.
- **Low cost**: This system is expected to be price competitive with other portable XRF systems using X-ray generators.

Applications

- Crime scene investigations (aids decision making in evidence collection)
  - – Gunshot residue (Ba, Sb, Pb, Sr)
  - – Blood, semen
  - – Paint chips, explosives, soil, glass, etc.
- Defense and homeland security
  - – Airport security
  - – Cargo inspection
  - – Weapons inspections
  - – Nuclear nonproliferation
  - – Land mine detection
  - – Hazardous area testing/ exploration
- Quality control
  - – Metal fabrication, foundry
  - – Pharmaceuticals
  - – Positive material identification
  - – Precious metals
  - – Art fraud
- Mining (geochemical exploration)
- Archeology
- Environmental monitoring/ remediation
- Scrap metal and plastics recycling
- Planetary exploration

Technology Details

How it works

Developed through a partnership between NASA Goddard Space Flight Center and the National Institute of Justice, this technology can be used for nondestructive, *in situ* elemental analysis. The technology's ability to detect any chemical element, combined with its novel software algorithm, allows the unit to detect the possible presence of gunshot residue as well as blood, semen, paint chips, and other crime scene evidence. Applications for NASA include geochemical and resource exploration of the moon, Mars, and other planets. See the sidebar for other possible applications

Designed to be self-contained, battery-operated, and rugged, the unit uses digitally controlled central and data processing units that can be operated remotely. The system uses a metal-ceramic X-ray tube and a cadmium telluride (CdTe) detector. Calibration can be automated, and the unit can be designed to include data accumulation, processing, storage, and transmission systems.

To rapidly determine the identity and quantity of elements and distinguish them from background radiation, the analysis process can divide the spectrum into energy sub-bands, reducing the algorithmic complexity of analyzing the entire spectrum at once. As a result, the system obtains accurate, virtually real-time results for hundreds of material classes. These algorithms also could be applied to neutron and gamma spectroscopic analysis.

The system's low-flux, micro-focused X-ray tube operates using a high-voltage, low-power, miniaturized, regulated power supply. This battery-based power supply can produce a variable voltage ranging from 20 to 60 kilovolts and variable currents of up to 100 microamps.

NASA Goddard Space Flight Center is pursuing patent protection for the technologies that make up the XRF system.

Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program, the goal of which is to transfer technologies into and out of NASA to benefit both NASA missions and the American public. NASA invites companies to consider licensing this technology for use in commercial applications.

For More Information

If you are interested in more information or want to pursue transfer of the portable XRF detector system (GSC-14796-1; GSC-14975-1; GSC-15301-1), please contact:

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More information about working with NASA Goddard's Office of Technology Transfer is available online:
http://techtransfer.gsfc.nasa.gov